Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

PRELIMINARY RESULTS OF A COMPARATIVE TEST OF THE 60-INCH AND 100-INCH TELESCOPES OF THE MOUNT WILSON OBSERVATORY

By George E. Hale

The close proximity on Mount Wilson of the 60-inch and 100-inch reflecting telescopes renders possible a comparative test of two similar instruments of large aperture. In order to make the results strictly comparable, the observations are preferably made simultaneously, and when these are photographic, the plates employed are taken from the same box and developed together for the same time. Other precautions necessary to eliminate sources of uncertainty are also observed.

The first simultaneous comparative tests of the series (which will be continued as opportunity offers thru several months) were made on August 13, 1919. The spectrum of the star ε *Andromedae* was photographed on Seed 30 plates with the two telescopes, using spectrographs having nearly identical optical constants, mounted at the Cassegrain focus.[1] For the 60-inch the equivalent focal length at this point is 80 feet, while for the 100-inch it is 134 feet. Both spectrographs have collimators of 2½ inches aperture and 40 inches focal length, and cameras of 4 inches aperture and 18 inches focal length. In each case a single 63° prism of 0.102 Jena glass is used, giving a dispersion of 36 angstroms to the millimeter with the camera employed. The slit-widths of the two spectrographs were varied until the photographic resolution determined by comparing close pairs of lines in the spectra of the same star, was found to be the same. The exposures on ε *Andromedae* were made by Dr. Strömberg with the 60-inch and by Dr. Merrill with the 100-inch, under good conditions of seeing.

Thirty-three spectrograms were secured for comparison. From twenty of these Dr. Strömberg finds the following mean ratios of exposure-times required to give the same intensities and photographic resolution with the two instruments:

Region	λ4000	λ4300	λ4500
Mean ratio	4.5	3.2	3.3

As the light undergoes three reflections in each telescope, and as the small mirrors cut out nearly the same proportion of light in both cases, the theoretical ratio of exposure times would be $\left(\frac{100}{60}\right)^2 = 2.78$. The presence of the plane mirror in the optical train of the spectrograph of the 60-inch telescope, and the fact that the three mirrors of the 100-inch telescope have been more recently silvered than those of the 60-inch, probably accounts for the comparatively high value of the ratio at λ4000 (4.5), as the comparison spectra show no such change of relative intensity with wave-length. But these differences cannot affect the brightness at λ4500 by more than 15 per cent, judging from the constancy of the exposure times for stars of a given magnitude required with the 60-inch thruout the dry summer season. Another comparison will be made after the mirrors of the 60-inch have been resilvered.

---

[1] The spectrograph of the 60-inch telescope contains a single plane mirror, not duplicated in the spectrograph of the 100-inch telescope.

A second comparative test, not based upon simultaneous exposures, is afforded by Dr. Merrill's experience with the stars of Class Md. Two hundred and one of these interesting objects, brighter than 9.0 magnitude at maximum, are known north of −30°. With the 60-inch nearly all of these stars can be observed for the bright lines with exposures not exceeding two hours. For the great majority, however, exposures of five hours or more are required with this telescope to yield a measurable absorption spectrum with the spectrographs already mentioned. In fact, so few stars can be effectively observed for both dark and bright lines that it would be hardly advisable to enter upon an extensive study of these objects with the 60-inch.

The greater light-gathering power of the 100-inch, however, renders such a study perfectly feasible. With this telescope, using the spectrograph mentioned above at the 134 foot Cassegrain focus, Dr. Merrill has obtained good photographs of the absorption spectrum (up to Hγ) of RY *Herculis*, 8.8 visual magnitude, in two hours, and of brighter stars of the same class with shorter exposures.

Dr. Shapley, who is continuing his investigation of star clusters with the 100-inch telescope, finds a similar gain of about one magnitude. With the small slitless spectrograph[2] mounted on the double-slide plate-holder at the 134-foot focus of the 100-inch, the exposure times for stars in the globular cluster Messier 11 are about as follows:

Photographic magnitude	Exposure
12	5 minutes
13	15 minutes

---

[2] This spectrograph has a collimator of 18 inches focal length, a 39° prism of 0.102 glass, and a camera of 3 inches focal length. The scale is Hγ−K = 0.9 mm.

A further advantage results from the greater scale of the cluster in this focus of the 100-inch, which permits the spectra of stars that overlap in the corresponding focus of the 60-inch to be photographed separately. The important results obtained by Dr. Shapley in photographing the spectra of cluster stars down to the sixteenth magnitude, with an exposure of about one hour at the 134-foot focus of the Hooker telescope, are described elsewhere in this number of the PUBLICATIONS. In this work a single prism of small angle was mounted a short distance in front of the plate.

Excellent direct photographs of the central part of Messier 13 have been made by Mr. Pease at the 134-foot focus. The large scale of these photographs will permit the magnitudes of the less crowded stars to be determined without so much difficulty from the Eberhard effect as has been experienced with the 60-inch. Photographs of the Moon of superb definition have also been obtained by Mr. Pease at the 134-foot focus of the Hooker telescope. Some of these will be reproduced in a future number of these PUBLICATIONS. The extraordinarily minute detail on the Moon that I have repeatedly seen with the Hooker telescope affords a most satisfactory indication of its qualities.

Campbell's star with hydrogen atmosphere (BD+30°3639) is a beautiful object with the 100-inch telescope. An account of the preliminary results of photographic and spectrographic observations by Mr. Pease of this star at the 134-foot focus may be found on page 276.

One of the most interesting results yet obtained with the Hooker telescope is due to Professor A. A. Michelson, who spent the evening of September 18th on Mount Wilson. Some years ago, by placing two movable slits in front of the objective of the 12-inch telescope of the Lick Observatory, he was able to measure the diameters of *Jupiter's* four satellites by determining the visibility of the interference fringes. The same method, if used with a telescope of sufficient aperture, should permit the angular diameter of a star to be measured. It was a question, however, whether the fringes could be seen with very large apertures. After making satisfactory preliminary tests with the 40-inch Yerkes refractor, Professor Michelson applied the same method to *Altair* with the 60-inch and 100-inch telescopes on Mount Wilson. The fringes were beautifully seen with the full aperture of the 100-inch, on a night when the seeing was only 2 to 3 on a scale of 10. It is thus probable that an interferometer of the necessary dimensions, permitting the mirrors to be placed as much as 25 feet apart, could be successfully used at Mount Wilson on the best nights. An instrument of this size is being designed by Professor Michelson to be carried on the mounting of the Hooker telescope. Meanwhile the 100-inch mirror, as used in the interference observations of *Altair*, will also be applied to the measurement of very close double stars and the diameters of the nuclei of novae and planetary nebulae. The surprising sharpness and steadiness of the fringes, as seen under a power of about two thousand, affords solid ground for the belief that this method will prove of great importance in future work.